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OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

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MEMORANDUM

SUBJECT: **Fipronil:** Ecological Risk Assessment for the Proposed Section 3 New Use of Fipronil-Treated Bait to Control Rodent-Associated Fleas and *Phlebotomus* Sand Fly Larvae

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The Environmental Fate and Effects Division (EFED) was asked to consider the potential risk from the proposed Section 3 new use of fipronil-treated bait (Kaput) to control rodent-associated fleas and *Phlebotomus* sand fly larvae. Bait is proposed to be scattered around burrows of Norway rats and prairie dogs. In addition, an application is proposed specifically for military use of bait applied around burrows or alternatively broadcast in areas less than 10 acres containing rodent hosts of flea and sand fly larvae. The product is intended to be consumed by the rodent and reportedly works systemically to control fleas feeding on the host rodent. Sand fly larvae are reportedly controlled via feeding on feces and other waste products of the host rodent. The proposed application rate is 10 lb of product (0.0005 lb ai)/A/single application. Reapplication to the same area is every other day for a total of three to four applications. This rate is intended

to provide a continuous supply of bait for six to eight days to provide feeding opportunities for the target mammals for at least five consecutive days. The proposed label indicates that follow-up applications may be repeated every three months (i.e., quarterly applications) for a maximum total of 16 applications during a 12-month period.

This abbreviated evaluation is based on the fipronil Registration Eligibility Decision (RED) chapter (USEPA, 2007) in part because the application rate of the proposed bait use (0.0005 lb ai/A; 50 mg ai/kg-bait) is much lower than rates previously assessed in the RED for other fipronil bait uses such as broadcast bait for ants (0.227 lb ai/A; 30 mg ai/kg-bait) and the overall risk picture is expected to be substantially similar. Additional characterization was conducted in cases where there was a risk concern for the ant bait given that it has a higher application rate than the proposed rodent bait on a lb ai/A basis (454X higher for a single application and 14X higher for the annual limit). Although the application rate is lower for the rodent bait on a lb ai/A basis, the concentration in the rodent bait is greater than in the ant bait. This is important because the concentration of fipronil in the bait impacts the risk potential for birds and mammals (i.e., more active ingredient is consumed per weight of bait); however, a risk concern was previously identified for birds and mammals based on the lower concentration in the ant bait. A comprehensive assessment of all fipronil uses is currently scheduled to be conducted for Registration Review.

Overall, a potential risk concern is expected mainly for birds (acute and chronic: listed and non-listed species) and mammals (acute: listed species; chronic: listed and non-listed species). There is a potential risk concern for aquatic invertebrates (acute: listed species; chronic: listed and non-listed species) as well; however, there is lower confidence about this risk because predicted exposure concentrations may overestimate actual exposure concentrations depending, in part, on the efficiency that animals remove the bait from the treated area. The RED indicated that fipronil may present risk to terrestrial invertebrates based on its well established effects on invertebrates; however, a quantitative analysis was not presented. In conclusion, consistent with other uses of fipronil there is a potential risk concern for aquatic organisms and terrestrial wildlife, including non-listed and listed species, for the proposed use on treated bait (**Table 1**).

Table 1. Risk Summary[1]

Taxa	Exposure Duration	Risk Concern?		Risk Quotient Range	Comments
		Non-Listed Species	Listed Species		
Mammals	Acute	No	Yes (secondary exposure only)	< LOC (primary exposure) 0.01-0.12 (secondary exposure)* *Range represents the maximum risk quotient (RQ) for each assessed combination of predator/prey weight classes. All predatory/prey combinations have RQs < LOC at some time points during the year.	Level of concern (LOC) exceedance is for medium (1000 g) and large (3000 g) mammals consuming small (20 g) birds or mammals. The LOC is exceeded for one to four days every three months (i.e., each quarterly treatment period).[2] The LOC is exceeded for carnivores/omnivores consuming 10 to 23 prey carcasses/day (85%-93% of the daily diet of the predator).[3] A wide-range of carnivores/omnivores may be potentially exposed.[4]

Taxa	Exposure Duration	Risk Concern?		Risk Quotient Range	Comments
		Non-Listed Species	Listed Species		
Mammals	Chronic	Yes		0.8-1.7 (primary exposure) 0.18-4.33 (secondary exposure)* *Range represents the maximum RQ for each assessed combination of predator/prey weight classes. All predatory/prey combinations have RQs < LOC at some time points during the year.	The lowest observed adverse effect concentration/level (LOAEC/L) is greater than exposure estimates (EECs) indicating that it is unknown if exposure would be high enough to elicit the effects observed in the toxicity study. The LOAEC/L is 10X greater than the no observed adverse effect concentration/level (NOAEC/L). Duration of exposure may be sufficient to elicit chronic effects. <u>Primary Exposure</u>[5] Potential exposure and risk concern for at least eight days every three months (i.e., each quarterly treatment period). Bait may be available for longer periods of time depending on the foraging pressure on the available bait. Potential for exposure is expected given that bait is intentionally placed in areas containing rodents, the bait is grain based, and grain is known to be attractive to a wide range of mammals. Exposure may occur in small spatial footprints (up to 10 acres) but those areas collectively represent a large spatial and wide geographic area of potential risk given that the product is proposed to be used in a variety of different settings. <u>Secondary Exposure</u> The LOC is exceeded for 3-21 days every three months (i.e., each quarterly bait treatment).[2] The LOC is exceeded for carnivores/omnivores consuming from less than one to six prey carcasses/day (23% to 87% of the daily diet of the secondary consumer).[3] A wide-range of carnivores/omnivores may be potentially exposed.[4]

Taxa	Exposure Duration	Risk Concern?		Risk Quotient Range	Comments
		Non-Listed Species	Listed Species		
Birds, reptiles, and terrestrial-phase amphibians	Acute	Yes	Yes	0.54-1.73 (primary exposure) 0.03-1.48 (secondary exposure)* *Range represents the maximum RQ for each assessed combination of predator/prey weight classes. All predatory/prey combinations have RQs < LOC at some time points during the year.	<u>Primary Exposure</u> Potential exposure and risk concern for at least eight days every three months (i.e., each quarterly treatment period). Bait may be available for longer periods of time depending on the foraging pressure on the available bait. Potential for exposure is expected given that bait is intentionally placed in areas containing rodents, the bait is grain based, and grain is known to be attractive to a wide range of birds. Exposure may occur in small spatial footprints (up to 10 acres) but those areas collectively represent a large spatial and wide geographic area of potential risk given that the product is proposed to be used in a variety of different settings. <u>Secondary Exposure</u> The LOC is exceeded for 2-34 days every three months (i.e., each quarterly bait treatment).[2] The LOC is exceeded for carnivores/omnivores consuming from less than one to 12 prey carcasses/day (7% to 91% of the daily diet of the secondary consumer).[3] A wide-range of carnivores/omnivores may be potentially exposed.[4]

Taxa	Exposure Duration	Risk Concern?		Risk Quotient Range	Comments
		Non-Listed Species	Listed Species		
Birds, reptiles, and terrestrial-phase amphibians	Chronic	Yes		5.0 (primary exposure) 0.55-3.78 (secondary exposure)* *Range represents the maximum RQ for each assessed combination of predator/prey weight classes. All predatory/prey combinations have RQs < LOC at some time points during the year.	No effects at the highest test concentration in the fipronil studies; however, the LOAEC would be exceeded for the structurally similar degradate fipronil desulfinyl. Duration of exposure may be sufficient to elicit chronic effects (assumed based on mammalian data). <u>Primary Exposure</u> Potential exposure and risk concern for at least eight days every three months (i.e., each quarterly treatment period). Bait may be available for longer periods of time depending on the foraging pressure on the available bait. Potential for exposure is expected given that bait is intentionally placed in areas containing rodents, the bait is grain based, and grain is known to be attractive to a wide range of birds. Exposure may occur in small spatial footprints (up to 10 acres) but those areas collectively represent a large spatial and wide geographic area of potential risk given that the product is proposed to be used in a variety of different settings. <u>Secondary Exposure</u> The LOC is exceeded for 1-19 days every three months (i.e., each quarterly bait treatment).[2] A wide-range of carnivores/omnivores may be potentially exposed.[4]
Terrestrial invertebrates (honeybees)	Acute Contact (Adult honeybee)	No		NA	Exposure is likely negligible given product is a solid bait.
	Acute and Chronic Dietary (Adult and larval honeybee)	No		NA	Exposure is likely negligible because the form of the product (grain-based bait) is unlikely attractive to honeybees nor is it compatible with a diet of pollen and nectar. Any fipronil that potentially reaches the soil (through degradation of the bait or in excreta from animals that consume the bait) would likely be at low concentrations and highly localized.

Taxa	Exposure Duration	Risk Concern?		Risk Quotient Range	Comments
		Non-Listed Species	Listed Species		
Terrestrial invertebrates (generic)	Acute and Chronic	Yes		NA	Qualitative assessment. Fipronil is an insecticide with demonstrable effects to terrestrial invertebrates. Exposure could occur through multiple pathways (*e.g.*, insects attracted to the bait, insects that bite/suck animals, and insects that consume feces).
Terrestrial plants	NA	No	No	< LOC	-
Fish[6]	Acute	No	No	< LOC	-
	Chronic	No		< LOC	
Aquatic invertebrates (water column)	Acute	No	Uncertain	0.049-0.195 (fipronil)* 0.049-0.198 (fipronil sulfone)* < LOC (fipronil sulfide and desulfinyl)*	Exceedance of acute listed species and the chronic LOC beginning with 2nd quarterly application but potential for risk concern is highly uncertain. EECs and RQs are extremely conservative (assumes all applied fipronil is available for run-off and instantaneously disassociates from bait matrix). *Range inclusive of 1st to 4th of annual quarterly applications for estuarine/marine invertebrates. Range is similar but RQs are slightly lower for freshwater invertebrates.
	Chronic	Uncertain		0.92-3.68 (fipronil)* 0.82-3.28 (fipronil sulfone)* < LOC (fipronil sulfide and desulfinyl)*	

Taxa	Exposure Duration	Risk Concern?		Risk Quotient Range	Comments
		Non-Listed Species	Listed Species		
Aquatic vascular plants	NA	No	No	< LOC	Based on conclusions of uses with higher exposure potential (USEPA, 2007).
Aquatic non-vascular plants					

[1] For purposes of this risk assessment, the secondary consumer/primary consumer relationship is also described as a predator (also implies scavenger)/prey relationship. Secondary consumers are also referred to as carnivores/omnivores. It is assumed that all combinations of weight class and taxonomic group (bird and mammal) are possible predator/prey relationships either through hunting or scavenging.
[2] The range represents different combinations of predator/prey taxonomic groups and weight classes. The number of days that the LOC is exceeded would vary depending on the actual number of days (total and frequency) that the prey consumes the bait.
[3] Each of the two ranges represent characterization of dose-based risk for different combinations of predator/prey taxonomic groups and weight classes on the day of maximum residues in prey animals. The number of prey needed to exceed the LOC would vary depending on the actual number of days (total and frequency) that the prey consumes the bait and on the residues in the prey animal on the day that it is consumed.
[4] A wide-range of carnivores/omnivores may be potentially exposed from secondary exposure given the range of weight class combinations with LOC exceedances and because of the wide geographic area of potential exposure given that the product is proposed to be used in a variety of different settings.
[5] The presented risk from primary exposure assumes that the bait is readily available for foraging. Use of bait stations may reduce the likelihood of (but not eliminate) primary exposure to birds and non-target mammals.
[6] Freshwater fish are a surrogate for aquatic-phase amphibians.
NA = not applicable

Additional Supporting Information

Birds and Mammals

There is a high degree of confidence that there is a potential risk concern for birds and mammals. The previous risk assessment concluded that there were potential risk concerns for use of ant bait containing a lower concentration of fipronil than the proposed rodent bait (30 mg/kg bait vs 50 mg/kg bait, respectively). Although the acute and chronic LOC were exceeded for the lower ant bait concentration, additional characterization was conducted to confirm the previous risk conclusions for two reasons. First, unlike the previously assessed ant bait, the proposed bait is targeted at specific mammals (*as discussed above*); therefore, this characterization is based on animal body weights that are representative of the targeted mammals. Second, the previous assessment identified potential risk from the direct consumption of bait ("primary exposure"); however, it did not consider the potential risk to animals that consume prey that have ingested bait ("secondary exposure"). This characterization includes determining the potential risk to these carnivorous/omnivorous birds and mammals.

Primary exposure (direct consumption of bait)

Consistent with previous findings, the acute (listed and non-listed species) and chronic LOC is exceeded for birds and the chronic LOC is exceeded for mammals from direct consumption of the bait (*see* **Appendix A**; bird acute RQs = 0.54-1.73; bird chronic RQ = 5.0; mammal chronic

RQs = 0.8-1.7). As expected, RQs are slightly higher for the proposed rodent bait containing a higher concentration of fipronil than the registered ant bait. There is greater certainty about the potential for acute risk to birds than for chronic risk to either birds or mammals for the following reasons. In the case of mammals, RQs (up to 1.7) exceed the LOC (1.0) based on the NOAEC and NOAEL but the LOC would not be exceeded based on the LOAEC/L which is 10X higher than the NOAEC/L; therefore, it is unknown how likely it would be that effects would be elicited from exposure to the bait. In the case of birds, the chronic RQ (5.0) based on the NOAEC exceeds the LOC (1.0) but it is unknown what concentrations will elicit effects because none were observed in the available studies. That said, it may be reasonable to expect chronic effects because they were observed at 13 mg ai/kg-diet (LOAEC) after Bobwhite quail were exposed to the structurally similar compound MB46513 (fipronil desulfinyl; MRID 49587409), which is also similar to fipronil in terms of acute toxicity to birds (within 2X for Bobwhite quail; MRID 42918617, 43776601, 49199502, 42918620, and 45259201). It is also important to remember that it is unknown if the timing or duration of exposure was critical to eliciting the chronic effects observed in birds and mammals in those reproductive studies. However, the proposed application may provide enough exposure in some cases to elicit chronic effects given that the bait is intended to be available on the field for up to eight days (the rate is intended to provide a continuous supply of bait for six to eight days to provide feeding opportunities for the target mammals for at least five consecutive days) and the bait may be applied at the same rate every three months (resulting in up to four windows of direct exposure during a 12-month period). In fact, the intended baiting period is in line with the timing of when effects were first observed in a rat developmental study with fipronil (MRID 42977903). In that study, effects were observed within 2 to 10 days of initial dosing (i.e., reduced maternal food consumption and body weight gain, respectively) and similar effects were also elicited in the rat 2-generation study with fipronil (MRID 42918647) reduced litter body weight, reduced maternal body weight gain, and reduced parental food consumption) at a roughly equivalent dose. This is suggestive that potential exposure during the intended treatment period may be sufficient to elicit chronic effects. Furthermore, the bait may be available on the landscape for even longer periods of time depending on the foraging pressure on the available bait.

Not only is there a potential concern if birds or mammals consume the bait but it is expected that there will be exposure given that the product is intended to be placed on the ground surface in areas containing rodents (i.e., in and around the ground near burrows or broadcast on the ground), is presumably attractive to animals, and can be placed in areas up to 10 acres in size for periods of up to eight days. In comparison, to the granular ant bait, the proposed grain-based rodent bait may potentially result in greater likelihood of exposure to birds and mammals given that it is attractive to mammals. This is not to say that the ant bait is less accessible to mammals and birds (both baits may be broadcast and placed in areas where mammals may be present) or that it is not an attractive food item, only that the proposed bait product is intentionally designed to attract consumption by mammals. Moreover, a wide-range of wildlife may be exposed because numerous birds (*e.g.*, many species of water birds, upland game birds, and song birds) and mammals (*e.g.*, rabbits, squirrels, chipmunks, mice, and prairie dogs) are known to consume grains (Martin *et. al.*, 1951). The known attraction of a wide range of animals to grains contributes significantly to the likelihood of a risk concern from the proposed use.

The duration period of bait availability also impacts the likelihood of exposure and risk. The longer that unconsumed bait remains toxic and available on the landscape beyond the treatment period (i.e., eight days every three months), the greater the likelihood of exposure and risk. In

general, it is reasonable to assume that bait may be available on the landscape for periods of time beyond the treatment period (i.e., eight days) because there may be excess bait available compared to the consumption rates of nearby foraging animals and any unconsumed bait may be slow to decompose under certain conditions. Many factors would contribute to decomposition rates of the bait, including but not limited to moisture levels (*e.g.*, weather or irrigation related), the composition of the grain bait (*e.g.*, whole seeds versus processed plant material), and the other components of the bait matrix (*e.g.*, parrafin). For example, dry conditions, use of whole seeds, and matrix components such as parrafin would all contribute to slower decomposition rates. Also important is the degradation of fipronil within the bait. Fipronil is relatively persistent and so it is likely that there will be primary exposure potential (direct consumption of bait) for birds and mammals as long as the bait itself remains intact and on the landscape.

Finally, although the potential risk is within relatively small spatial areas for any given application (i.e., up to 10 acres for the military use), those areas collectively represent a large spatial and wide geographical area of potential risk given that the product is proposed to be used in a variety of different settings (i.e., parks, golf courses, rangeland, pasture, alfalfa, wheat, pastures, barley, fruit tree orchards, non-crop rights-of-way and other non-crop areas, and military installations).

In conclusion, the weight-of-evidence indicates a high degree of confidence that there is a potential risk concern for birds and mammals from the direct consumption of the proposed product.

Secondary exposure (consumption of prey that consumed fipronil-treated bait)

Secondary exposure, like primary exposure, may lead to adverse effects on birds and mammals. The potential risk concerns are similar to those from primary (direct consumption of bait) exposure (i.e., birds: acute and chronic (listed and non-listed species); mammals: chronic (listed and non-listed species)) with one exception; acute risk to listed mammal species (*see* **Appendix A**). There is not an acute risk concern for small mammals that are the target for direct consumption of the bait. This makes sense because the product is not designed to kill the rodents, rather it is designed to kill the labeled pests associated with those rodents. However, there is an acute risk concern for larger carnivorous/omnivorous mammals (*e.g.*, listed species in the 1000 and 3000-g size classes; RQs up to 0.12; LOC = 0.10) that prey upon small rodents (*e.g.*, 20-g size class) or small birds (*e.g.*, 20-g size class). One consideration of the LOC exceedance is that residues in the prey are predicted to be high enough for only 1-4 days per treatment period (i.e., every three months) to be a potential risk concern (*see* **Appendix A**). Another consideration is that the number of small (20-g) birds or mammals that would need to be consumed is 10 to 23, representing 93% and 85% of the daily diet of the 1000 and 3000-g predator size classes, respectively. Although not implausible, the window is relatively short and a relatively high number of contaminated animals need to be obtained and consumed for there to be a risk concern.

In regard to acute risk to birds, the number of prey that would need to be consumed is much lower than that for mammals. Therefore, the likelihood of a secondary exposure risk concern may be greater for birds. For example, a 100-g carnivorous/omnivorous bird (*e.g.*, an American kestrel) would need to eat less than one (representing 34% of its daily diet) small (20-g) bird or mammal to exceed the non-listed species LOC (*see* **Appendix A**). The window of potential

secondary risk concern is generally similar to that from primary exposure (i.e., minimum of eight days for direct consumption of bait)[1] for birds that eat birds (i.e., up to 15 days for listed carnivorous/omnivorous species and nine days for non-listed carnivorous/omnivorous species) (*see* **Appendix A**). In some cases, that window may be longer for birds that eat mammals (up to 34 days for listed carnivorous/omnivorous species and 16 days for non-listed carnivorous/omnivorous species). For example, the LOC is exceeded for small non-listed species of carnivorous/omnivorous birds (100-g) consuming 20-g mammal prey for up to 16 days per treatment period (i.e., every three months). On the other hand, the exposure window of concern for secondary exposure may actually be shorter for birds or mammals that consume mammals. This is because the estimated residues in mammals (body burden of fipronil in prey from direct consumption of bait) are based on an elimination rate constant derived from an exposure concentration (4 ppm ai) that is closest to but lower than the bait concentration (50 ppm ai). Higher exposure concentrations (such as that in the bait) may lead to more rapid elimination than that observed from exposure to 4 ppm in the available rat metabolism study (MRID 42918655). In that study, exposure to 150 ppm ai resulted in more rapid elimination of fipronil than in rats exposed to 4 ppm ai. The study authors suggested that the more rapid elimination at the higher dose may have been due to reaching the saturation level of absorption mechanisms. It is unknown if exposure to 50 ppm ai (i.e., the bait concentration) would result in more rapid elimination than observed at 4 ppm ai; however, residue levels in prey exposed to 50 ppm ai would be lower than predicted (*see* **Appendix A**) to the extent that the elimination rate of fipronil in rats exposed to 50 ppm ai exceeds that in those exposed to 4 ppm ai. That said, the predicted residue levels in prey may only modestly overestimate the exposure window of concern for secondary exposure. For example, the window for exceeding the acute non-listed species LOC for birds eating mammals ranges from 10 days to 16 days based on elimination rate constants representing exposure to 150 ppm ai and 4 ppm ai, respectively.

Chronic risk concerns and the associated uncertainties regarding toxicity (*described above*) are similar to those for direct exposure. In the case of birds, RQs for secondary exposure are less than those for primary exposure whereas for mammals it depends on if exposure is based on diet (secondary exposure RQs < primary exposure RQs) or dose (primary exposure RQs < secondary exposure RQs) (*see* **Appendix A**). Nonetheless, the secondary-exposure chronic LOC (1.0) is generally exceeded for a range of animals of different sizes (maximum RQs[2] for birds range from 0.55 to 3.78 and for mammals range from 0.18 to 4.33). The window of potential secondary chronic risk concern is similar to that described above for acute risk concern. In other words, it is generally similar to that from primary exposure for birds or mammals that eat birds (up to 11 days) and slightly longer for birds or mammals that eat mammals (up to 21 days). As for acute secondary exposure risk, the analysis suggests that the potential window for a chronic risk concern from secondary exposure to both bird and mammal carnivore/omnivore species is consistent with and may extend longer than that for primary exposure to birds and mammals (limited by the duration that bait is available on the field, which is at a minimum of eight days each quarterly treatment period).

[1] Bait is placed every two days for up to four applications. Therefore, the minimum period of availability is eight days. However, bait could be available on the landscape for longer periods of time if not completely consumed by target or non-target animals.

[2] Maximum RQs for secondary exposure represent the day with the highest body burden (i.e., concentration of fipronil) in the prey animal for each assessed size class. Body burden and RQs are lower on other days due to elimination.

As for primary exposure, a wide-range of wildlife may be exposed from secondary exposure because there is a potential concern for numerous weight classes of carnivorous/omnivorous birds and mammals. Furthermore, there is wide geographic area of potential exposure given that the product is proposed to be used in a variety of different settings. Representative bird species of the weight classes of concern include American kestrel, red-tailed hawk, and bald eagle. For mammals, representative species include mink and kit fox. It is important to note that these species are only representative of the weight classes and are not necessarily species that would be exposed. Secondary exposure potential for any given carnivore/omnivore species will depend in part on the location of the contaminated prey relative to the range of the predator and on prey species preferences, if any, of those predators.

In conclusion, there is a potential risk concern for a wide range of birds and mammals of different sizes from either direct consumption of the bait or secondary consumption (predators/scavengers consuming prey that consumed the bait). The likelihood of risk to any given weight class of bird or mammal (primary or secondary consumer) is expected to vary widely and be influenced by a myriad of variables. However, this analysis suggests that there is a potential risk concern for animals that is broad in scope across animal sizes and dietary preferences.

Honeybees

The RED concluded that there was a potential risk concern for terrestrial invertebrates (USEPA, 2007) for registered uses given that fipronil is an insecticide with demonstrable effects on target insects. It is assumed that the proposed bait product may cause adverse effects to non-target terrestrial invertebrates as well. Exposure could occur to species attracted to the grain-based bait, non-target biting/sucking insects, or insects that consume feces (i.e., of the target-rodent or other animals that may have ingested the fipronil). In contrast, there is no risk concern for honeybees because exposure is expected to be *de minimus*. First, contact exposure to honeybees is likely negligible given that the product is a solid bait. Second, dietary exposure to honeybees is likely negligible because the form of the product (grain-based bait) is unlikely attractive to honeybees nor is it compatible with their diet of pollen and nectar. Furthermore, any fipronil that potentially reaches the soil (i.e., through degradation of the bait) or excreta from animals that consume the bait would likely be at low concentrations and highly localized.

Aquatic Organisms

There was a potential risk concern identified for fish and aquatic invertebrates for the higher application rate of the ant bait; therefore, additional characterization of potential risk to these taxonomic groups was considered for the lower application rate of the proposed rodent bait. As a screen, it was assumed that the previously assessed use on ant bait (application rate of 0.227 lb ai/A x 2 with a reapplication interval of 30 days; USEPA, 2007) would be representative of the proposed bait use after linearly scaling the EECs and therefore RQs to the lower application rate of the proposed product. For example, it was assumed that EECs and RQs for the 1st quarter set of four rodent bait applications (0.0005 lb ai/A x 4) are 227X lower than those for ant bait as presented in the RED. The RED analysis assumed application to a lawn in a region of the country that receives considerable rainfall (Florida turf scenario). Regions with less rainfall would likely have less potential for transport with runoff to waterbodies. Since the Kaput label does not geographically limit product usage, the scenario used in the RED (after scaling) likely

serves as an appropriate surrogate of the higher rainfall areas to which the product is applied and a conservative scenario in lower rainfall areas. The acute and chronic LOC are not exceeded for fish based on an annual application of the rodent bait (0.0005 lb ai/A x 16). However, the acute listed species LOC (RQ = 0.098 for fipronil and 0.099 for fipronil sulfone) and the chronic listed/non-listed species LOC (RQ = 1.8 for fipronil and 1.64 for fipronil sulfone) are exceeded for aquatic invertebrates after the second quarterly application of the proposed product (0.0005 lb ai/A x 8).[3] Confidence in the lack of a risk concern for fish is greater than that for the potential risk concern for aquatic invertebrates. This is because the EECs are based on the assumption that all of the applied bait is available for run-off from the treated field and that all the fipronil in the bait is instantaneously disassociated from the bait matrix. Both of these assumptions should be extremely conservative in most situations. First, the product is intended to be attractive to mammals and will likely be removed in part or in full from the treated field. Second, the bait is likely to release fipronil slowly if left to degrade without ingestion. Third, although the label permits surface broadcast of the product, it also may be applied by scattering some of the product not only around but also in burrows. Furthermore, the EECs do not account for dissipation of the bait or of fipronil between quarterly applications.

In conclusion, the risk identified for the ant bait use (fish and aquatic invertebrates) covers any potential risk from the proposed rodent use given the much lower application rate (454X lower for a single application and 14X for the annual limit). It is reasonable to conclude that there is not a risk concern for fish from the proposed rodent bait use given the lack of an LOC exceedance based on the highly conservative screening EECs. Likewise, there is not a concern for aquatic invertebrates after four applications (1st quarterly set). Although there is an exceedance of the LOCs (acute listed species and chronic) beginning with the 2nd quarterly application set, this assumes that all of the fipronil and bait applied in the 1st quarter application set is available for run-off with the fipronil and bait applied with the 2nd quarterly application. Although there is potential risk, there is a high degree of uncertainty. Refinements would be complex and require assumptions about factors including the typical removal efficiency of the product by animals and breakdown of the bait product.

References

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USEPA, 1993. Wildlife Exposure Factors Handbook, Volume I of II. Office of Research and Development.

USEPA, 2007. Ecological Risk Assessment for Current and Proposed Residential and Crop Uses of Fipronil. Office of Chemical Safety and Pollution Prevention. DP 331595+

[3] Presented results are based on toxicity to estuarine-marine invertebrates. Risk picture is similar for freshwater invertebrates (similar but slightly lower RQs). The RQs for fipronil sulfone reflect the correction of a typo in the RED (USEPA, 2007) regarding the LC_{50} value (correct value is 0.056 µg/L). The LOC is not exceeded based on exposure to either fipronil sulfide or fipronil desulfinyl.

Appendix A: Representative Characterization of Risk to Birds and Mammals

A-1. Risk from Primary Exposure (Direct Consumption of Bait; 50 mg ai/kg bait)

Formulas for Calculating Fipronil Exposure to Animals that Ingested Fipronil Bait and Resultant Risk to those Animals (Primary Exposure)

Box A-1.1

Representative Primary Consumers of Bait

Body weight classes of mammals were chosen to represent target species and a small granivorous species. Three body weight classes of passerine species were chosen because it was assumed that they are more likely to peck at the bait than non-passerine species.

Birds
20 g (small passerine); 100 g (medium passerine); 1000 g (large passerine)

Mammals
20 g (mouse); 250 g (rat); 1000 g (Prarie dog)

Box A-1.2

Fipronil Intake of Primary Consumer

Fipronil Intake (mg ai/kg-bw/day) = ((kg wet-weight food intake/day) x (mg ai/kg bait))/(kg-bw of primary consumer) (USEPA, 1993)

Where:

Food intake (g wet-weight/day) = F1 (g dry-weight/day)/0.90 (USEPA, 1993)
F1 Food intake of birds (g dry-weight/day) = 0.398 x (g primary consumer $bw^{\wedge 0.850}$) (USEPA, 1993; assumes passerine species)
F1 Food intake of mammals (g dry-weight/day) = 0.621 x (g primary consumer $bw^{\wedge 0.564}$) (USEPA, 1993; assumes rodents: target consumers of the bait)
Wet-weight of bait assumed 10% water (using seed wet-weight as a surrogate; USEPA, 1993)
Fipronil concentration in bait (mg ai/kg) = 50 (product label)

Box A-1.3

Fipronil Toxicity

Birds
Acute oral LD_{50} = 11.3 mg ai/kg-bw (MRID 42918617)
Adjusted toxicity (LD_{50}) = 11.3 mg ai/kg-bw x (g bw primary consumer/g-bw test bird)$^{\wedge 0.15}$
Where:
Body weight of test bird (Bobwhite quail) = *assumed* 178 g
Acute dietary LC_{50} = 48 mg ai/kg-diet (MRID 42918620)
Chronic NOAEC = 10 mg ai/kg-diet (MRID 42918622)

Mammals
Acute oral LD_{50} = 97 mg ai/kg-bw (MRID 42918628)
Adjusted toxicity (LD_{50}) = 97 mg ai/kg-bw x (g-bw test mammal/g-bw primary consumer)$^{\wedge 0.25}$
Where:
Body weight of test mammal (rat) = *assumed* 350 g
Chronic NOAEC = 30 mg ai/kg-diet (MRID 42918647)
Chronic NOAEL = 2.64 mg ai/kg-bw (MRID 42918647)
Adjusted toxicity (NOAEL) = 2.64 mg ai/kg-bw x (g-bw test mammal/g-bw primary consumer)$^{\wedge 0.25}$
Where:
Body weight of test mammal (rat) = *assumed* 350 g

Box A-1.4

RQ calculation

Dose-based (LD_{50}/NOAEL) = Fipronil intake (mg ai/kg-bw/day)/Toxicity (mg ai/kg-bw)
Dietary-based (LC_{50}/NOAEC) = Fipronil concentration in bait (mg ai/kg bait)/Toxicity (mg ai/kg-diet)

Table A-1.1. Acute and Chronic RQs for Primary Consumers of Bait

Animal	Animal weight (g)	Food intake (g dry-wt/day)	Food intake (g wet-wt/day)	Fipronil intake (mg ai/kg-bw/day)	Fipronil Concentration in bait (mg ai/kg)	Acute dose-based toxicity (LD_{50}, weight adjusted) (mg ai/kg bw)	Acute dietary-based toxicity (LC_{50}) (mg ai/kg-diet)	Chronic dose-based toxicity (NOAEL, weight adjusted) (mg ai/kg-bw)	Chronic dietary-based toxicity (NOAEC) (mg ai/kg-diet)	RQ			
										Acute dose-based	Acute dietary-based	Chronic dose-based	Chronic dietary-based
Bird	20	5.1	5.6	14.1	50	8.1	48	NA	10	**1.73**	**1.04**	NA	**5.0**
	100	19.9	22.2	11.1		10.4				**1.07**			
	1000	141.2	156.9	7.8		14.6				**0.54**			
Mammal	20	3.4	3.7	9.3		198.4	NA	5.4	30	0.05	NA	**1.7**	**1.7**
	250	14.0	15.5	3.1		105.5		2.9		0.03		**1.1**	
	1000	30.6	34.0	1.7		74.6		2.0		0.02		0.8	

BOLD exceeds listed/non-listed species LOC. Acute listed species LOC = 0.1; Acute non-listed species LOC = 0.5; Chronic listed/non-listed species LOC = 1.0
NA = not applicable

A-2. Risk from Secondary Exposure

Formulas for Calculating Fipronil Body Burden in Animals that Directly Consume Fipronil Bait (Primary Exposure)

Box A-2.1

Representative Primary Consumers of Bait

Body weight classes of mammals were chosen to represent target species and a small granivorous species. Three body weight classes of passerine species were chosen because it was assumed that they are more likely to peck at the bait than non-passerine species.

Box A-2.2

Residue Retention Rate in Primary Consumers of Bait

Bird specific

Retention of dose at 24-hr (fraction/day) = $e^{\text{^-retention "k"}}$

Where

Retention "k" = -Ln (1-mean daily loss as % of daily dose/100)

Mean daily loss as % of daily dose (Hen metabolism study: doses administered 28 consecutive days; MRID 43401106) = 30.86

- Based on the administered daily dose (10 ppm; highest tested) closest to the proposed bait concentration (50 ppm)
- Daily loss is based on percent of daily administered radioactivity recovered in excreta only (excludes elimination in eggs to be protective of non-laying hens and males)
- Mean is of daily losses during the first 8 days of the dosing to match labeled application rate (assumed up to 8 continuous days of feeding opportunity as intended by the label)

Mammal specific

Retention of dose at 24-hr (fraction/day) = $e^{\text{^-retention "k"}}$

Where:

Retention "k" = -Ln (1-mean total loss after 7 days as % of single dose/100)/7 days

Mean total loss after 7 days as % of single dose (Rat metabolism study: single-dose and 7-day observation; MRID 42918655) = 51.4

- Based on the administered daily dose (4 ppm; lowest tested) closest to the proposed bait concentration (50 ppm)
- Total loss is based on total recovery in excreta only at study termination (168-hr post single dose)

Box A-2.3

Body Burden in Primary Consumer for 1st Quarterly Set of Bait Applications (day 1-90): *Assumes bait is consumed each day of the treatment period (day 1-8) and that no bait is consumed during the non-treatment period (day 9-90)*

- The following equations are repeated in series for each subsequent quarterly set of applications except for the "day 1" equation (*e.g.*, day 91-98 treatment period and day 99-180 non-treatment period for 2nd quarter).

Treatment Days (1-8 for 1st quarter)

$$\text{Animal body burden (mg ai/kg-bw) on Day 1} = \frac{\text{Ingestion rate of animal x Concentration in bait}}{\text{Animal body weight}}$$

$$\text{Animal body burden (mg ai/kg-bw) on Day z} = \text{Animal body burden on Day z} - 1 \times \text{Animal residue retention rate} + \frac{\text{Ingestion rate of animal x Concentration in bait}}{\text{Animal body weight}}$$

Non-treatment Days (9-90 for 1st quarter)

$$\text{Animal body burden (mg ai/kg-bw) on Day z} = \text{Animal body burden on Day z} - 1 \times \text{Animal residue retention rate}$$

Where:

Ingestion rate of animal (kg/day) = (Kcal/day energy requirement of animal)/(Kcal/kg grain energy content) x (animal assimilation efficiency of grain)
Fipronil concentration in bait (mg ai/kg) = 50 (product label)
Grain energy content (Kcal/kg) = 5100 (USEPA, 1993)

Bird specific

Body weight primary consumer of bait (kg) = 0.020, 0.100, and 1
Residue retention rate (fraction/day) = 0.691 (MRID 43401106, *see* calculations in Box A-2.2)
Energy requirement (Kcal/day) = 2.123 x g bird body weight$^{\wedge 0.749}$ (USEPA, 1993; assumes passerine species)
Assimilation efficiency of grain = 0.8 (USEPA, 1993)

Mammal specific

Body weight primary consumer of bait (kg) = 0.020, 0.250, and 1
Residue retention rate (fraction/day) = 0.902 (MRID 42918655, *see* calculations in Box A-2.2)
Energy requirement (Kcal/day) = 2.514 x g mammal body weight$^{\wedge 0.507}$ (USEPA, 1993; assumes rodents: target consumers of the bait)
Assimilation efficiency of grain = 0.85 (USEPA, 1993)

Formulas for Calculating Fipronil Intake Based on Consumption of Animals that Ingested Fipronil Bait and Resultant Risk to those Secondary Consumers

Box A-2.4

Representative Secondary Consumers

Body weight classes were chosen to represent the generally larger size of carnivores relative to the full body weight range of all birds and mammals. Examples of species within those weight classes are shown in parentheses.

Birds
100 g (American kestrel); 1000 g (Red-tailed hawk); 5000 g (Bald eagle)

Mammals
50 g (Least weasel); 1000 g (mink); 3000 g (Kit fox)

Box A-2.5

Fipronil Intake of Secondary Consumer

Fipronil Intake (mg ai/kg-bw/day) = ((kg wet-weight food intake/day) x (mg ai/kg of prey carcass))/(kg-bw of secondary consumer)

Where:

Food intake (g wet-weight/day) = F1 (g dry-weight/day)/0.32 (USEPA, 1993)
F1 Food intake of birds (g dry-weight/day) = 0.648 x (g secondary consumer bw$^{\wedge 0.651}$) (USEPA, 1993)
F1 Food intake of mammals (g dry-weight/day) = 0.235 x (g secondary consumer bw$^{\wedge 0.822}$) (USEPA, 1993)
Residues in prey carcass (mg ai/kg-bw) (*see* body burden calculations in Box A-2.3)
Wet-weight of prey carcass assumed 68% water (USEPA, 1993)

Box A-2.6

Fipronil Toxicity

Birds
Acute oral LD_{50} = 11.3 mg ai/kg-bw (MRID 42918617)
Adjusted toxicity (LD_{50}) = 11.3 mg ai/kg-bw x (g bw secondary consumer/g-bw test bird)$^{\wedge 0.15}$
Where:
Body weight of test bird (Bobwhite quail) = *assumed* 178 g
Acute dietary LC_{50} = 48 mg ai/kg-diet (MRID 42918620)
Chronic NOAEC = 10 mg ai/kg-diet (MRID 42918622)

Mammals
Acute oral LD_{50} = 97 mg ai/kg-bw (MRID 42918628)
Adjusted toxicity (LD_{50}) = 97 mg ai/kg-bw x (g-bw test mammal/g-bw secondary consumer)$^{\wedge 0.25}$
Where:
Body weight of test mammal (rat) = *assumed* 350 g
Chronic NOAEC = 30 mg ai/kg-diet (MRID 42918647)
Chronic NOAEL = 2.64 mg ai/kg-bw (MRID 42918647)
Adjusted toxicity (NOAEL) = 2.64 mg ai/kg-bw x (g-bw test mammal/g-bw secondary consumer)$^{\wedge 0.25}$
Where:
Body weight of test mammal (rat) = *assumed* 350 g

Box A-2.7

RQ calculation

Dose-based (LD_{50}/NOAEL) = Fipronil intake (mg ai/kg-bw/day)/Toxicity (mg ai/kg-bw)
Dietary-based (LC_{50}/NOAEC) = Residues in prey carcass (mg ai/kg of prey carcass)/Toxicity (mg ai/kg-diet)

 # Prey carcasses that must be Consumed to Exceed LOC (dose-based assessment)

prey = mg ai required to exceed LOC for secondary consumer/mg ai per prey carcass

Where:

mg ai required to exceed LOC for secondary consumer = (adjusted toxicity (LD_{50}/NOAEL) for body weight of secondary consumer (mg ai/kg-bw) x LOC) x (kg-bw of secondary consumer)
Acute LOC = 0.1 (listed species) and 0.5 (non-listed species)
Chronic LOC = 1.0 (listed and non-listed species)
mg ai per prey carcass = residue in prey carcass (mg ai/kg carcass) x kg-bw of prey carcass

% of Secondary Consumer Daily Diet to Exceed Acute LOC

% daily diet = ((# prey to exceed LOC x g-bw of prey carcass)/food intake of secondary consumer (g wet-weight/day)) x 100

Where:

Food intake of secondary consumer (g wet-weight/day) (*see* calculation in Box A-2.5)

Box A-2.8

A note about Table A-2.1

RQs and characterization are presented for the day of maximum fipronil residues in prey. The full time series (1-year) is shown in **Figures A-2.1-A-2.4**.

Table A-2.1. Acute and Chronic RQs for Secondary Consumers and Characterization of LOC Exceedance

Prey			Secondary Consumer																	
			Food intake (g dry-wt/day)	Food intake (g wet-wt/day)	Fipronil intake (mg ai/kg-bw/day)	Acute dose-based toxicity (LD_{50}, weight adjusted) (mg ai/kg bw)	Acute dietary-based toxicity (LC_{50}) (mg ai/kg-diet)	Chronic dose-based toxicity (NOAEL, weight adjusted) (mg ai/kg-bw)	Chronic dietary-based toxicity (NOAEC) (mg ai/kg-diet)	Acute dose-based					Acute dietary-based	Chronic dose-based			Chronic dietary-based
Prey	Prey weight (g)	Residue in carcass of prey (mg ai/kg carcass)								RQ	# prey to exceed listed LOC	% diet	# prey to exceed non-listed LOC	% diet	RQ	RQ	# prey to exceed non-listed / listed LOC	% diet	RQ
Secondary Consumer (100-g bird)																				
Bird	20	37.53	12.9	40.6	15.24	10.4	48	NA	10	**1.47**	0.14	7	0.69	34	**0.78**	NA	NA	NA	**3.75**
	100	25.06			10.17					**0.98**	0.04	10	0.21	51	**0.52**				**2.51**
	1000	14.06			5.71					**0.55**	0.01	18	0.04	91	**[*0.29*]**				**1.41**
Mammal	20	37.83			15.36					**1.48**	0.14	7	0.68	34	**0.79**				**3.78**
	250	10.89			4.42					**0.43**	0.04	23	NA	NA	**[*0.23*]**				**1.09**
	1000	5.49			2.23					**[*0.22*]**	0.02	46			**[*0.11*]**				0.55
Secondary Consumer (1000-g bird)																				
Bird	20	37.53	58.2	181.7	6.82	14.6	48	NA	10	**[*0.47*]**	1.95	21	NA	NA	**0.78**	NA	NA	NA	**3.75**
	100	25.06			4.55					**[*0.31*]**	0.58	32			**0.52**				**2.51**
	1000	14.06			2.55					**[*0.17*]**	0.1	57			**[*0.29*]**				**1.41**
Mammal	20	37.83			6.87					**[*0.47*]**	1.93	21			**0.79**				**3.78**
	250	10.89			1.98					**[*0.14*]**	0.54	74			**[*0.23*]**				**1.09**
	1000	5.49			1.00					0.07	NA	NA			**[*0.11*]**				0.55
Secondary Consumer (5000-g bird)																				
Bird	20	37.53	165.8	518.1	3.89	18.6	48	NA	10	**[*0.21*]**	12.41	48	NA	NA	**0.78**	NA	NA	NA	**3.75**
	100	25.06			2.60					**[*0.14*]**	3.72	72			**0.52**				**2.51**
	1000	14.06			1.46					0.08	NA	NA			**[*0.29*]**				**1.41**
Mammal	20	37.83			3.92					**[*0.21*]**	12.32	48			**0.79**				**3.78**
	250	10.89			1.13					0.06	NA	NA			**[*0.23*]**				**1.09**
	1000	5.49			0.57					0.03					**[*0.11*]**				0.55

Prey			Secondary Consumer																	
			Food intake (g dry-wt/day)	Food intake (g wet-wt/day)	Fipronil intake (mg ai/kg-bw/day)	Acute dose-based toxicity (LD_{50}, weight adjusted) (mg ai/kg bw)	Acute dietary-based toxicity (LC_{50}) (mg ai/kg-diet)	Chronic dose-based toxicity (NOAEL, weight adjusted) (mg ai/kg-bw)	Chronic dietary-based toxicity (NOAEC) (mg ai/kg-diet)	Acute dose-based					Acute dietary-based	Chronic dose-based			Chronic dietary-based
Prey	Prey weight (g)	Residue in carcass of prey (mg ai/kg carcass)								RQ	# prey to exceed listed LOC	% diet	# prey to exceed non-listed LOC	% diet	RQ	RQ	# prey to exceed non-listed / listed LOC	% diet	RQ
Secondary Consumer (50-g mammal)																			
Bird	20	37.53	5.9	18.3	13.74	157.8	NA	4.29	30	0.09	NA	NA	NA	NA	NA	**3.20**	0.29	31	**1.25**
	100	25.06			9.17					0.06						**2.14**	0.09	47	0.84
	1000	14.06			5.15					0.03						**1.20**	0.02	83	0.47
Mammal	20	37.83			13.85					0.09						**3.22**	0.28	31	**1.26**
	250	10.89			3.99					0.03						0.93	NA	NA	0.36
	1000	5.49			2.01					0.01						0.47			0.18
Secondary Consumer (1000-g mammal)																			
Bird	20	37.53	68.7	214.7	8.06	74.6	NA	2.03	30	**[*0.11*]**	9.94	93	NA	NA	NA	**3.97**	2.71	25	**1.25**
	100	25.06			5.38					0.07	NA	NA				**2.65**	0.81	38	0.84
	1000	14.60			3.02					0.04						**1.49**	0.14	67	0.47
Mammal	20	37.83			8.12					**[*0.11*]**	9.86	92				**4.00**	2.68	25	**1.26**
	250	10.89			2.34					0.03	NA	NA				**1.15**	0.75	87	0.36
	1000	5.49			1.18					0.02						0.58	NA	NA	0.18
Secondary Consumer (3000-g mammal)																			
Bird	20	37.53	169.5	529.8	6.63	56.7	NA	1.54	30	**[*0.12*]**	22.66	86	NA	NA	NA	**4.30**	6.17	23	**1.25**
	100	25.06			4.43					0.08	NA	NA				**2.87**	1.85	35	0.84
	1000	14.06			2.48					0.04						**1.61**	0.33	62	0.47
Mammal	20	37.83			6.68					**[*0.12*]**	22.48	85				**4.33**	6.12	23	**1.26**
	250	10.89			1.92					0.03	NA	NA				**1.25**	1.70	80	0.36
	1000	5.49			0.97					0.02						0.63	NA	NA	0.18

BOLD exceeds listed/non-listed species LOC. [***BOLD***] only exceeds listed species LOC. Acute listed species LOC = 0.1; Acute non-listed species LOC = 0.5; Chronic listed/non-listed species LOC = 1.0 NA = not applicable

Figure A-2.1. Acute Risk to Bird and Mammal Predators from Secondary Exposure (Consumption of Birds)

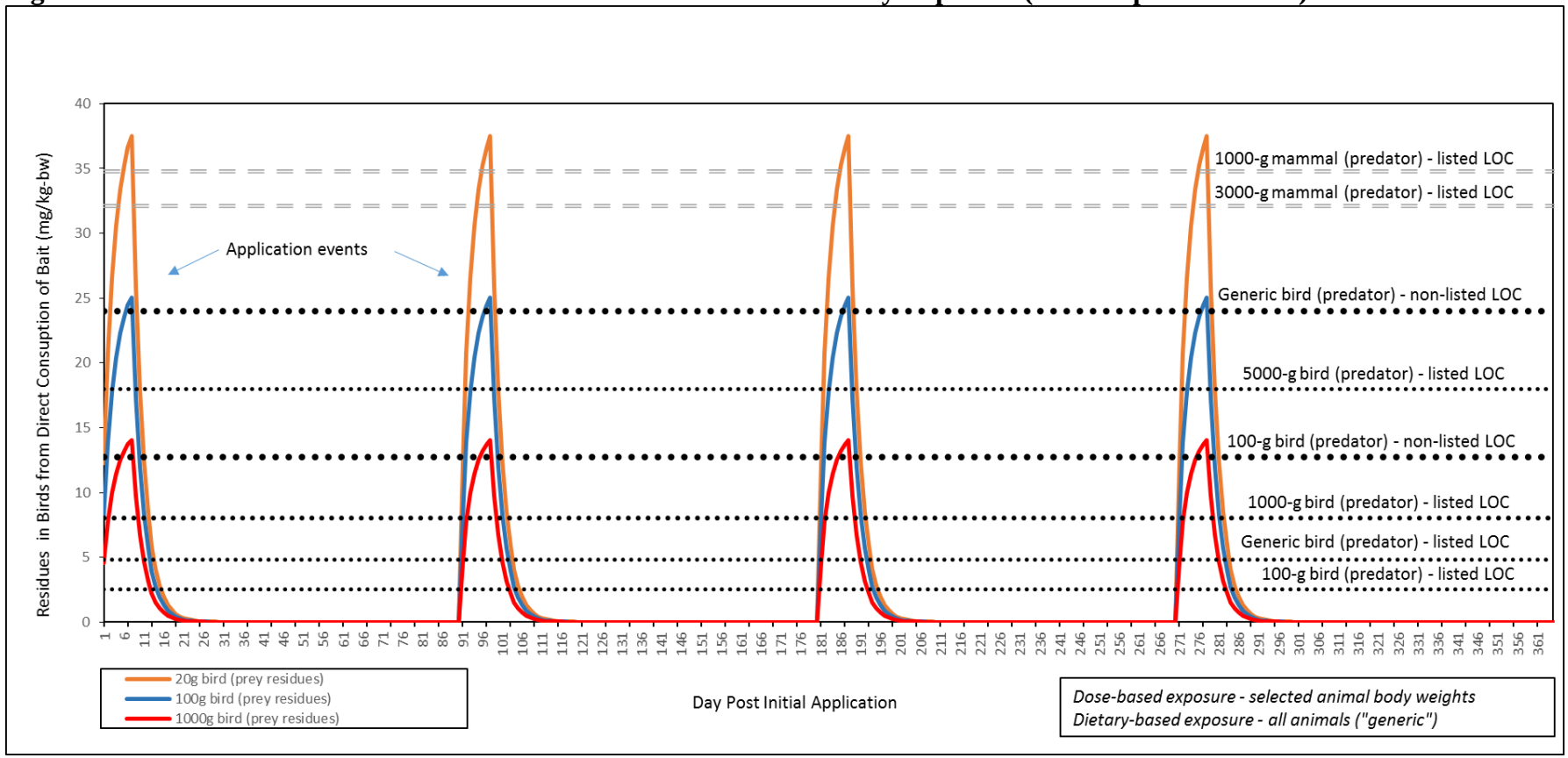

Figure A-2.2. Chronic Risk to Bird and Mammal Predators from Secondary Exposure (Consumption of Birds)

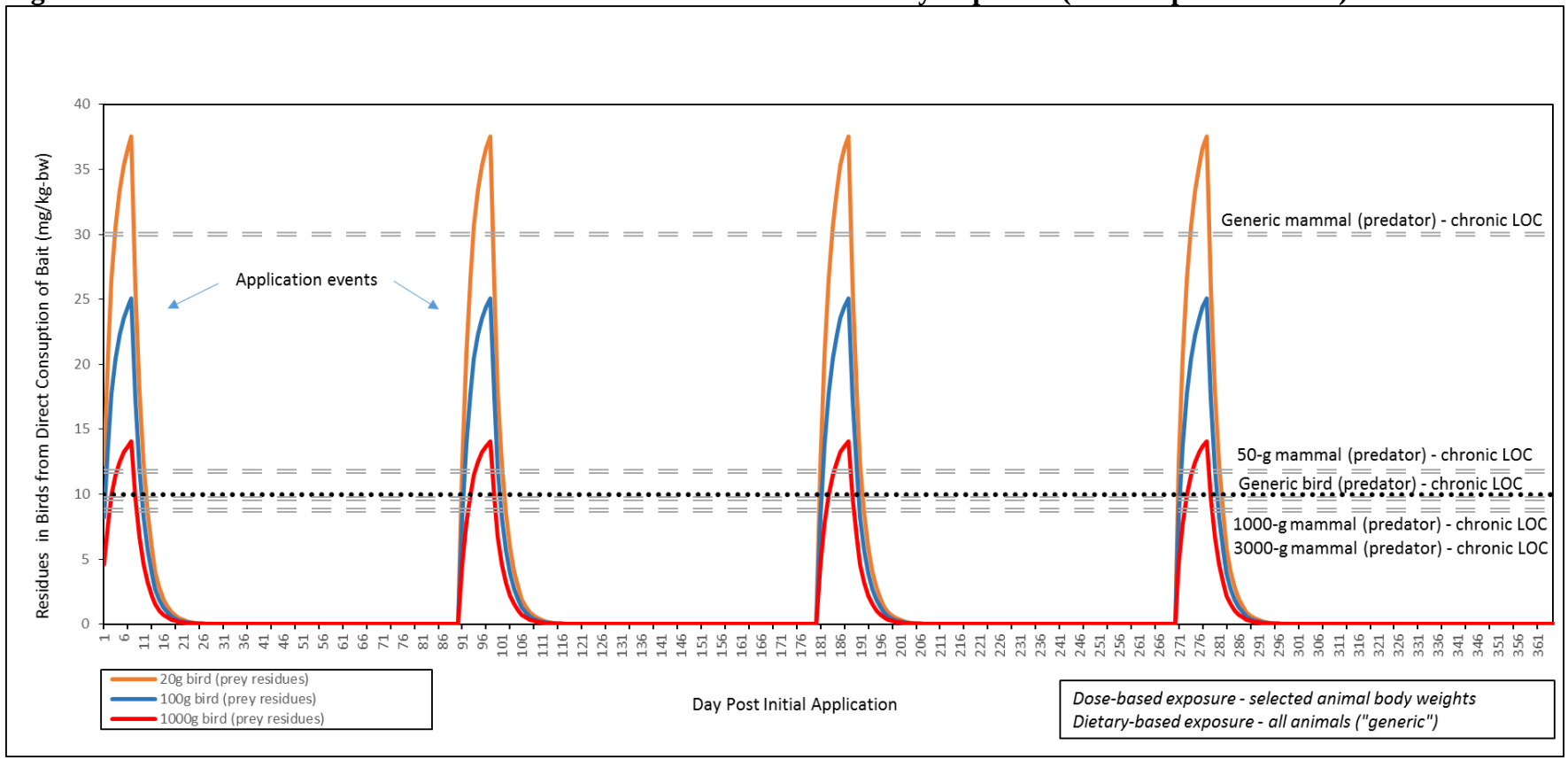

Figure A-2.3. Acute Risk to Bird and Mammal Predators from Secondary Exposure (Consumption of Mammals)

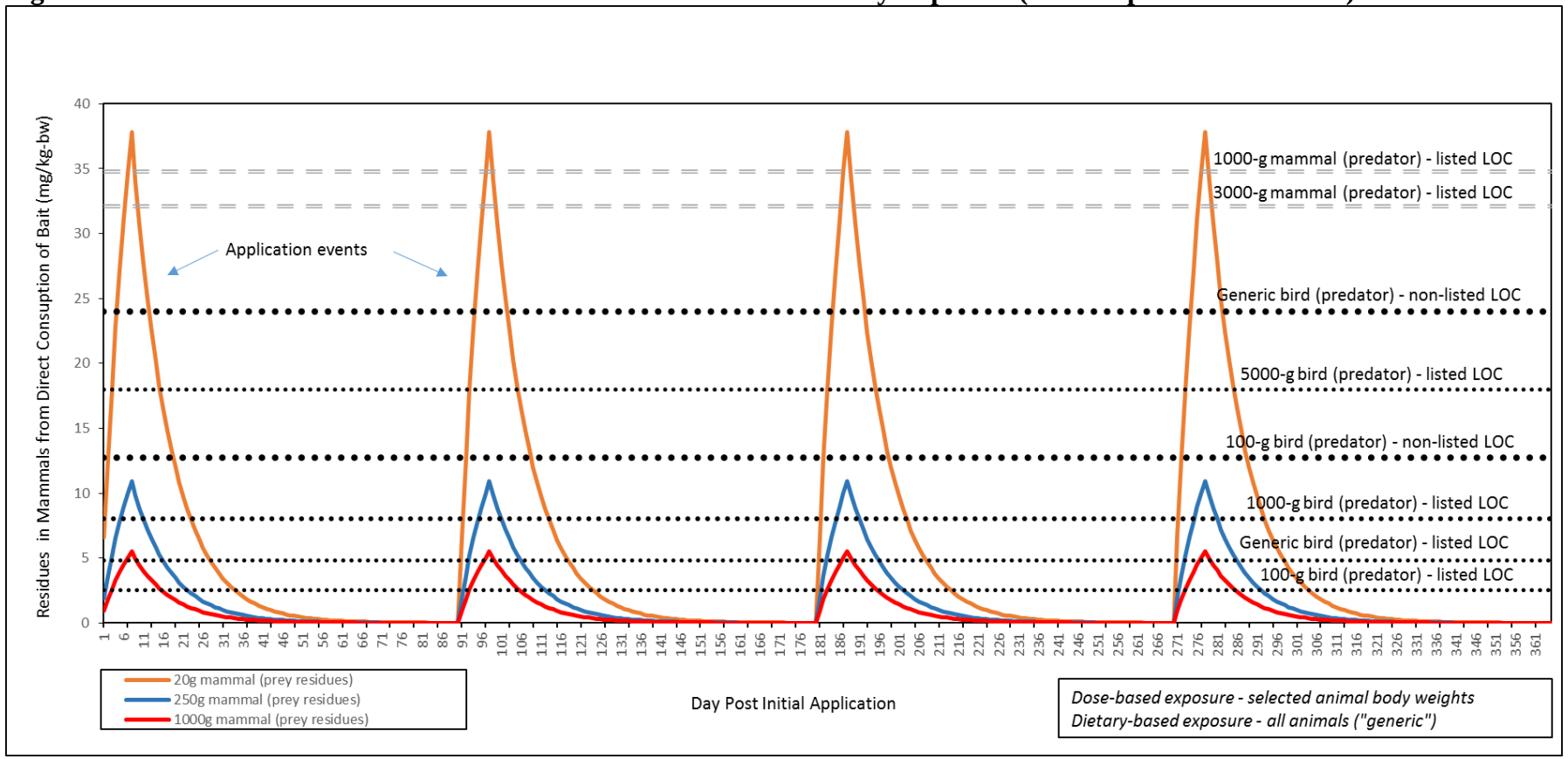

Figure A-2.4. Chronic Risk to Bird and Mammal Predators from Secondary Exposure (Consumption of Mammals)